APPENDIX B

ALTERNATIVE PLAN FORMULATION

Metro Waterways Tool Box

Tool Box of Solutions

Eugene-Springfield Metro Waterways Study

May 2006

The toolbox is an interactive application designed to facilitate the decision-making process when choosing what type of project should be undertaken to improve waterway conditions.
The toolbox process begins by identifying the **Issue/Factors** that needs to be addressed at a specific site. Staff and Technical Assistance Pool input along with public comment narrowed the scope to a list of seven core issues. These are listed in the farthest left column on the matrix.

The **Potential Tools** column lists the types of techniques that can be applied to address the issue of concern. There are many **Potential Tools** for each **Issue/Factor**. The **Potential Tools** were compiled and summarized from extensive research on waterway enhancement and restoration techniques in the region and around the country. Some of these tools are tried and true, while others are more innovative and do not yet have a well established rate of success.

After identifying the **Issue/Factor** and the **Potential Tools**, the toolbox includes a *Selection Features* section, which summarizes the most important considerations for each individual tool. There are eight columns in the *Selection Features* section.

1. The **Benefits** column indicates the type of benefit(s) the tool is likely to produce when implemented. Many of the tools produce multiple benefits. The benefits are broken into four major categories, which relate directly to the study's planning objectives and the categories used in the channel assessment methodology. These include:
   - **Physical** (bank stability, bed stability, sediment, flood conveyance)
   - **Water Quality** (absorption/filtration, aeration, shade/temperature, bank integrity)
   - **Natural Resource** (riparian width, riparian vegetation, terrestrial habitat, aquatic habitat structure, and wildlife corridor function)
   - **Social** (public access, facilities, community amenity)

2. The **Cost** column gives an indication of how much the tool will cost to implement. Although costs may vary significantly, this column gives project staff a base approximation to work from. In some cases, too many variables exist to develop a cost estimate (*Highly Variable*).

3. **Typical Scale of Application** gives a spatial definition for each tool by assigning one of five potential scales to each tool. A tool can be assigned Region, Watershed, Corridor, Segment, or Point Specific depending on its size and scope.

4. The **Life Span** column indicates how long a properly designed and constructed tool will last under normal conditions and maintenance. The Life Span can be **Long** (permanent solution), **Medium** (requires eventual replacement after many years), or **Short** (needs to be redone on an annual of bi-annual basis).

5. **Proven Effectiveness** is based upon the history of a tool, previous research, and case studies. This column explains where a tool is most effective and points out issues that may not be effectively addressed with the specific tool.

6. The **Maintenance Needs** column explains the ongoing operational and maintenance commitments that must be understood before implementing the tool.

7. **Permits Needed** gives a broad picture of what documentation must be obtained to implement a tool. There are three levels of permits needed: Local, State, and Federal.

8. The **Other** column describes any special considerations of each tool such as general advantages/disadvantages, access requirements, and other relevant information.

Issues/Factors	Potential Tools	Selection Features							
		Benefits	**Cost**	**Scale of Application**	**Life Span**	**Proven Effectiveness**	**Maintenance Needs**	**Permits Needed**	**Other**
		- Physical *- Water Quality* *- Natural Resource* *- Social*	*Estimated Range of Cost*	*- Region* *- Watershed* *- Corridor* *- Segment* *- Point Specific*	*- Long* *- Medium* *- Short*	*Short description of effectiveness*	*Short description of maintenance commitments*	*- Federal* *- State* *- Local*	*- Advantages* *- Disadvantages* *- Access Needs* *- Suitable Conditions*
Channel Stability • Channel incision (bed scour) • Bank erosion (slumping, rotational failure at toe of bank) • Failing revetment (specifically along the McKenzie River) • Flow Velocity (erosion, stability)	*Soft Bank Stabilization* - examples: • Assess channel and geomorphic conditions as basis for formulating site specific restoration measures • Riparian vegetation: protect, restore • Coir Fiber Logs • Erosion control fabrics • Soil lifts • Live stakes • Live fascines • Brush mattresses • Replace revetment with soft bank techniques • Remove in-channel structures causing erosive flow velocities • Streambank shaping (see "channel widening" below)	• Physical (bank stability, flow retention, energy dissipation) • Water Quality (filtration, temperature, bank integrity) • Natural Resource (terrestrial/aquatic habitat, native vegetation, wildlife corridor, sanctuary habitat) • Social (community amenity)	• Vegetation restoration: low when compared to other tools; can often be accomplished with volunteers • $1 - $3/plant: live stakes • $5 - $10/lf: revetment removal/replace with softbank techniques • $5 - $30/lf: coil fiber; soil lifts; live fascines • $30 - $50/lf: brush mattress • $1 - 5/sq yd: erosion fabric (installed)	Point-specific; Segment; Corridor	Medium - Long	• Effective in stabilizing banks • Not effective stabilizing channel bottom. • Effective in retaining or restoring "naturalized" habitat and aesthetic appearance.	• Vegetation restoration: high maintenance first few seasons; annual monitoring • Soil lifts, live stakes, brush mattress, coir logs: frequent inspections first few seasons, then annually. • Live facines: minimal • Replace revetment: frequent monitoring first few years for structural integrity and vegetation survival.	Federal, State, Local.	Vegetation restoration: • Sun exposure important • Heavy equipment not needed • Invasive weed management • Potential role for volunteer groups, watershed councils • Success rate improves with use of native vegetation
	Hard Bank Stabilization – examples: • Boulder revetment • Rootwad revetment • Imbricated rip-rap • A-Jacks • Live cribwalls	• Physical (bank stability, energy dissipation) • Water Quality (bank integrity) • Social (protect at-risk property)	• $20 - $40/lf river bank: boulder revetment • $60 - $90/lf: rip-rap; A-Jacks • $250 - $350/lf: live cribwall • $50 - $330/ea: rootwad revetment (onsite) • $250 - $600/ea: rootwad revetment (off-site)	Point-specific; Segment	Medium	In general, hard bank solutions are: • Effective in stabilizing banks, but not channel bottoms. • If incision is an issue, other techniques should be used in conjunction with these.	• Boulder: monitor after first big storms for stability; • Rootwad: monitor initial years to detect scour; • Rip-rap: monitor monthly first 6 months for stability • A-jacks: minimal • Cribwalls: monitor for vegetation and stability first growing season. • Each requires on-going annual inspections	Federal, State, Local	• Applicable for wide variety of conditions. • Requires toe protection, grade control if addressing incision. • Requires heavy equipment. • Can change flow dynamics resulting in potential upstream, downstream stability problems. • Permit and T&E requirements could preclude revetment option

Issues/Factors	Potential Tools	Selection Features							
		Benefits	Cost	Scale of Application	Life Span	Proven Effectiveness	Maintenance Needs	Permits Needed	Other
(con't) **Channel Stability** • Channel incision (bed scour) • Bank erosion (slumping, rotational failure at toe of bank) • Failing revetment (specifically along the McKenzie River) • Flow Velocity (erosion, stability)	*In-stream Grade Control & Flow Deflection* – examples: • Gravel/Boulders (incision) • Large wood (bank erosion, incision) • Log, Rock, J-Rock Vanes (toe erosion) • V-log drops (bank erosion, incision) • Rock cross vane (bank erosion, incision) • Step pools (incision, energy dissipater)	• Physical (bed and bank stability, flow retention, energy dissipation) • Natural Resource (aquatic habitat, sanctuary habitat) • Water Quality/Aquatic habitat restoration	Costs vary depending on width/size, etc: • $50 - $300/lf: gravel/boulders, • $250 - $800/ea: large wood • $400 - $1400/ea: log/rock/J-rock vanes • $800 - $2600/ea: V-log drops • $1200 - $5,000/ea: rock cross vane • $800 - $6000/lf: step pools	Point-specific; Segment	Short to medium	• Gravel/boulders: short-term fix; effective only if properly sized for bed transport capacity • Large wood: experimental • V-logs: effective for small, low gradient streams with cobble/gravel bedload • Step pools: effective if designed for all flow levels • Vanes: effective in low gradient streams • Cross vane: appropriate for low – moderate grades; avoid sand-bed streams	• Gravel/boulders: Monitor after high flow events and repair as necessary • Large wood: minimal • V-logs: Monitor after high flow events, repair as needed. • Step pools: minimal • Vanes: monitor after large storms first year and check for stability. Most common problem is erosion at streambank • Cross vane: minimal	Federal, State. Local	
	Redesign Channel: • *Widen channel* • *Layback stream bank grades to not exceed 2:1 with 3:1 ideal* • *Introduce side channels* • *Where possible, identify existing, healthy stream as a "reference site" for designing overall restoration measures*	• Physical (bed and bank stability, flow conveyance, flow retention, energy dissipater through reduced flow velocities) • Water Quality (filtration, shade, bank integrity) • Natural Resource (riparian width, aquatic/terrestrial habitat, sanctuary habitat) • Social (community amenity)	• $250/lf (City of Eugene): construction costs • Land acquisition costs can vary significantly	Segment	Long	Very effective and for achieving other multiple objectives: • Water quality • Habitat restoration • Aesthetic Local experience with this tool has been very successful.	• Frequent monitoring of initial growing season to ensure adequate soil moisture for seed germination and growth. May need supplemental irrigation • Streambanks should be monitored after first significant storm event for erosion and soil loss. • Document "as-construct" channel design for baseline reference. • Long-term monitoring to track overall performance and to identify and remedy invasive species.	Federal, State, Local	• ESA issues, as applicable, can limit scope of project and timing of construction. • Channel widening is dependent on the availability of adequate space • Acquisition costs are a significant factor • Requires extensive landowner collaboration.
	Parallel Pipes	• Physical (bed, bank stability) • Water Quality (bank stability) • Natural Resources (aquatic habitat)	• $50 - $300/lf, depending on pipe size	Segment	Long	Very effective, particularly in steep, hillside headwater areas.	• Inlet clogging requires on-going maintenance	Local	• Maintaining base flow and small storm flows to the repair stream is critical for maintaining in-stream habitat.
	Manage public access	• Physical (bank stability) • Natural Resource (terrestrial habitat) • Social (access, facility)	Trails: $5 - $10/lf	Corridor	Long	Effective in reducing damage to riparian areas and sediment loads due to erosion.	Trail/Trailhead maintenance		
	Riparian protection ordinance	• Physical (bank stability, sediment reduction, energy dissipation) • Water Quality (shade, filtration, bank integrity) • Natural Resource (habitat, wildlife corridor) • Social (preserve community amenity)	Primarily administrative costs for: • Initial ordinance preparation, public involvement processing, adoption • On-going costs: development review, inspections, enforcement	Region	Long		None		Can be affected by local politics and potentially subject to Measure 37 claims. Successful implementation depends on effective development review, inspection, and enforcement programming.

Issues/Factors	Potential Tools	Selection Features							
		Benefits	Cost	Scale of Application	Life Span	Proven Effectiveness	Maintenance Needs	Permits Needed	Other
Water Quality/Aquatic Habitat • Pollutants of Concern (Temperature, Dissolved Oxygen, Nutrients, Bacteria, Turbidity, Toxics, Mercury) • Water Quality Function Condition (riparian cover, shade cover; channel stability, dissolved oxygen) • ESA Related (Oregon Chub, Spring Chinnok) • Pollutants of Concern (Temperature, Dissolved Oxygen, Nutrients, Bacteria, Turbidity, Toxics, Mercury) • Water Quality Function Condition (riparian cover, shade cover; channel stability, dissolved oxygen) • ESA Related (Oregon Chub, Spring Chinnok)	*Protect/Restore Riparian Vegetation*– examples*:* • Protection Ordinance • Acquisition • Financial incentives • Capital enhancement projects	• Physical (bank stability, flow retention, energy dissipation) • Water Quality (filtration, shade, bank stability, aeration) • Natural Resource (terrestrial/aquatic habitat, sanctuary habitat) • Social (community amenity)	• Regulatory protection costs are relatively low when compared to other capital projects • Acquisition protection measures are comparatively high especially within urban areas. • Capital project costs are relatively low	Segment, Corridor	Long	• Effective at controlling erosion, stabilizing banks; moderating temperature, filtering/uptaking pollutants.	• Regulations require on-going development review, inspections, enforcement • Restoration requires monitoring and maintenance in initial years.		Regulations can be affected by local politics and potentially subject to Measure 37 claims. Restorations can use volunteer groups.
	Vegetation Planting for Stream Shading	• Physical (bed, bank stability) • Water Quality (sediment, bank stability)Natural • Resources (aquatic habitat)		Segment	Long	• Generally effective for moderating temperature	• Initial years following planting require more monitoring and maintenance.		Potential role for volunteer groups, watershed councils
	Protect/Restore Forest Canopy – examples: • Protection ordinance for steep, hillside headwater areas • Acquisition • Financial incentives • Capital enhancement projects	• Water Quality (filtration, shade, flow retention) • Natural Resources (terrestrial habitat,) • Social (community amenity)	• Regulatory protection costs are relatively low when compared to other capital projects • Acquisition protection measures are comparatively high especially within urban areas • Incentives: tax credit; stormwater fee/sdc reduction • Capital project costs are relatively low	Watershed		• Effective at reducing runoff, erosion; filtering/uptaking pollutants; moderating temperature	• Regulations require on-going development review, inspections, enforcement • Restoration requires monitoring and maintenance in initial years.		Regulations can be affected by local politics and potentially subject to Measure 37 claims. Restorations can use volunteer groups.
	Implement Applicable NPDES Permit & TMDL Stormwater Programming Requirements (Best Management Practices, Capital Projects, Illicit Discharges, Education Outreach, etc)	• Water Quality (pollutant prevention/reduction)	• Per applicable program budgets of each jurisdiction	Region, Watershed, Corridor Segment	Long	Generally, most techniques, methods have proven effective and/or adapted overtime as experience grows.	Per programming requirements.	Federal, State, Local	
	Create Base Flow Channel (i.e., within the existing concrete channel in Amazon Creek)	• Water Quality (temperature) • Natural Resource (aquatic habitat)	$400 - $1400/lf for vanes or deflectors	Segment	Medium	Effective in urban streams that have widened channels and lateral instability. Effective in reducing erosion at the toe of the bank.	Inspect after large storms to check for stability.	Federal, State, Local	Not suitable in high gradient streams with highly mobile bedloads.
	Channel widening, shaping, redesign, and introduction of new side channels (spread flow, filtration, more capacity for riparian vegetation)	• Physical (bed and bank stability, flow conveyance, flow retention, energy dissipation) • Water Quality (filtration, shade, bank integrity) • Natural Resource (riparian width, aquatic and terrestrial habitat, sanctuary habitat) • Social (community amenity)	• $250/lf (City of Eugene): construction costs • Land acquisition costs can vary significantly	Segment	Long	Very effective and for achieving other multiple objectives: • Bank/channel stability • Habitat Local experience with this tool has been very successful.	• Frequent monitoring of initial growing season to ensure adequate soil moisture for seed germination and growth. • Streambanks should be monitored after first significant storm event for erosion and soil loss. • Document "as-built" design for baseline reference • Long-term monitoring to track performance and to identify any problems in early stages.	Federal, State, Local	• ESA issues, as applicable, can limit scope of project and timing of construction. • Channel widening is dependent on the availability of adequate space • Acquisition costs are a significant factor

Issues/Factors	Potential Tools	Selection Features							
		Benefits	Cost	Scale of Application	Life Span	Proven Effectiveness	Maintenance Needs	Permits Needed	Other
(cont.) **Water Quality/Aquatic Habitat**	*Animal Waste Management Program* (feeding waterfowl, dog/pet waste) design): • Education • Inspection • Design	• Water Quality (pollutant removal) • Social (community amenity)		Segment	Long				Potential role for volunteer groups, watershed councils
	Education/Clean-up/stream adoption/waste collection programs	• Water Quality (pollutant removal) • Social (community amenity)	Varies depending on donated time and materials	Region, Watershed	Long	Very effective in making the site more aesthetically pleasing.	• Repeated clean-ups are much more effective. • Important to monitor for illegal dumping.		• Access to site is a major consideration. • Potential role for volunteer organization, watershed councils. • Safety of volunteers
Adequate Flow • Water intake not functioning • Water rights not secure	*Secure water rights*	• Water quality (temperature) • Natural Resource (aquatic habitat) • Social (secures water for agricultural uses)	Varies	Watershed	Long				
	Re-construct water intake structure	• Water quality (temperature) • Natural Resource (aquatic habitat) • Social (more efficient water distribution)		Point Specific	Medium	Reduce intake velocities screen for fish exclusion. Long-term maintenance required.	Fish passage or exclusion will increase monitoring and maintenance costs	Federal, State, Local	• Potential land ownership issues • Remote control of vale intake would improve effectiveness of this facility
	Establish connection with hyporheic zone	• Water Quality (temperature)		Corridor					
In-Channel Habitat • Barriers to fish passage • Lack of channel diversity • No side channels • Lack of gravel recruitment • Threatened and endangered species	*Habitat features*: • Large wood • Lunkers • Boulders clusters • Riparian canopy for stream shading • Replace culverts	• Natural Resource (aquatic habitat, sanctuary habitat) • Water Quality (temperature)	• $60 - $250/ea: Boulder Cluster • $360 - $500/ea: Lunker • $20 to $40/lf: Large wood	Segment	Medium	Very effective in creating habitat features and adding complexity to channel	• Large Wood, Boulders, Lunkers: size and placement should be recorded and checked annually for movement. • Riparian Canopy: requires high maintenance initial years to ensure survival; 5-10 year monitoring.	Federal, State, Local	• Can dramatically alter flow conditions and stream morphology. • Safe boater passage required for boatable streams.
	Channel widening and introduction of side channels (spread flow)	• Physical (bed and bank stability, conveyance, flow retention, energy dissipation) • Water Quality (filtration, shade, bank integrity) • Natural Resource (riparian width, aquatic/terrestrial habitat, sanctuary habitat) • Social (community amenity)	Approximately$250/lf (Based on City of Eugene experience)	Segment	Long	Very effective and for achieving other multiple objectives: • Bank stability • Channel stability • Water quality • Aesthetic Local experience with this tool has been very successful.	Vegetation Management	Federal, State, Local	• Requires extensive landowner collaboration
	In-stream stormwater pond	• Physical (conveyance, flow retention, energy dissipation) • Water Quality (absorption/filtration) • Natural Resource (aquatic habitat, sanctuary habitat)		Segment	Long	Most effective in headwaters area to reduce peak flows in downstream areas		Federal, State, Local	Coordinate with USFWS & ODFW

Issues/Factors	Potential Tools	Selection Features							
		Benefits	Cost	Scale of Application	Life Span	Proven Effectiveness	Maintenance Needs	Permits Needed	Other
(con't) **In-Channel Habitat** • Barriers to fish passage • Lack of channel diversity • No side channels • Lack of gravel recruitment • Threatened and endangered species	*Install gravel*	• Natural Resource (aquatic habitat)	$50-$250/lf	Segment	Medium	Effective in encouraging spawning, but fish passage barriers are first priority.		Federal, State, Local	• Appropriate in shallow streams with mid-sized bedloads and few pools. • Must be considered with fish passage improvements.
	Remove/modify culverts (daylighting)	• Water Quality (filtration) • Natural Resource (terrestrial and aquatic habitat, riparian width) • Social (public access, community amenity, aesthetic)	$150 to $350/lf	Segment	Long	Very effective in addressing habitat concerns and improving aesthetics. Many examples.	• Annual maintenance timed with fish migration. • If associated with fish passage, long-term monitoring and maintenance required.	Federal, State, Local	• Restores natural character • Education important for gaining community support. • Potential role for volunteer groups, watershed councils. • Day-lighting highly dependent on adequate space and availability of land
	Restore wetlands	• Physical (water storage) • Water Quality (absorption/filtration) • Natural Resource (terrestrial/aquatic habitat, sanctuary habitat) • Social (community amenity)	$50,000/acre	Segment or Corridor	Long	Highly effective in addressing multiple objectives. Many examples.	5-year monitoring (minimum) required	Federal, State, Local	• Need to weigh potential issues with wetlands converting mercury to methylmercury which can then move into the food chain. • Potential role for volunteer groups, watershed councils.
Riparian (off-channel) Habitat • Lack of vegetation • Lack of habitat • Invasive species • Threatened and Endangered species	*Riparian planting (native species) and invasive weed removal(off-channel)*	• Physical (bank stability) • Water Quality (absorption/filtration, temp.) • Natural Resource (riparian width, terrestrial habitat, wildlife corridor function) • Social (community amenity)	Varies, but generally low compared to other capital projects	Segment	Long	Effective for encouraging native habitat	Vegetation management; invasive weed control; landowner involvement.		Requires extensive landowner collaboration. Role for volunteer groups, watershed councils.
	Channel widening and introduction of side channels (spread flow)	• Physical (bed and bank stability, flow conveyance) • Water Quality (filtration, shade, bank integrity) • Natural Resource (riparian width, aquatic and terrestrial habitat, vegetation) • Social (community amenity)	Approximately$250/lf (Based on City of Eugene experience)	Segment	Long	Very effective for achieving multiple objectives: • Bank stability • Channel stability • Habitat restoration • Aesthetic Local experience with this tool has been very successful.	• Vegetation Management • T & E species requires on-going monitoring and adaptive management practice.	Federal, State, Local	Requires extensive landowner collaboration.
	Floodplain Restoration	• Physical (bank stability, flow conveyance) • Water Quality (filtration, bank integrity) • Natural Resource (riparian, aquatic and terrestrial habitat, vegetation) • Social (community amenity)	Varies	Segment	Long	• Very effective for restoring floodplain-related habitat. • Dragon fly Bend is a local example of a very successful restoration project.	Requires rigorous initial management to ensure properly functioning condition.	Federal, State, Local	• Ownership and land availability of issues.

Issues/Factors	Potential Tools	Selection Features							
		Benefits	Cost	Scale of Application	Life Span	Proven Effectiveness	Maintenance Needs	Permits Needed	Other
(cont.) **Riparian (off-channel) Habitat**	*Removal of portions of concrete walled channel (one or both sides as conditions allow)*	• Water Quality (filtration, temperature) • Natural Resource (riparian width, riparian vegetation, terrestrial/aquatic habitat, wildlife corridor function) • Social (public access, community amenity)	$750/lf (Upper Amazon Creek Enhancement Study – 2000)	Segment	Long	Effective at decreasing flow velocities	Would increase maintenance requirements, at least initially.	Federal, State, Local	• Highly dependent on having adequate space. • Soil-based channel could increase erosion and bank stability problems to adjacent landowners
	Acquisition/protection of existing riparian habitats	• Natural Resource (preserves/improves existing habitat)	Varies	Corridor or Watershed	Long				• Ownership and land availability issues. • Potential role for watershed councils.
Community Vitality/Public Access • Waterway is visually unattractive • Is not an amenity to adjacent properties • No public access to waterway due to steep banks, lack of trails, or land not in public ownership • Structures or obstructions in waterway prevents access by boat • Trespass and illegal camping • Headgate system ownership	*Remove/modify culverts (daylighting) and fish passage barriers*	• Water Quality (filtration) • Natural Resource (terrestrial and aquatic habitat, riparian width) • Social (public access, community amenity)	$150 to $350/lf	Segment	Long	Very effective in addressing habitat concerns and improving aesthetics. Many examples.	• Annual maintenance timed with fish migration. • If associated with fish passage, long-term monitoring and maintenance required.	Federal, State, Local	• Restores natural character to urban streams. • Education is important to gain community support.
	Channel widening and introduction of side channels (spread flow)	• Physical (bed and bank stability, flow conveyance) • Water Quality (filtration, shade, bank integrity) • Natural Resource (riparian width, aquatic and terrestrial habitat, vegetation) • Social (community amenity)	Approximately$250/lf (Based on City of Eugene experience)	Segment	Long	A very effective tool to both strengthen the bank and stabilize the streambed	Vegetation Management	Federal, State, Local	
	Develop multi-use path system/pedestrian bridges (on public lands or, in special cases, with private property owner agreement or with access easement)	• Social (public access, community amenity)	Path: $75-125/lf Bridge example: 100 ft. long/12 ft. wide ($100/sq. ft) = $120,000	Corridor	Medium	Effective in managing access.	Periodic edge mowing	Federal, State, Local	• Potential social conflict with users and landowners. • Pathways should be setback from top-of-bank to minimize potential damage due to bank failure
	Develop soft surfaced trails	• Social (public access, community amenity)	$5-10/lf	Corridor	Short	• Effective in managing access. • Successful examples are along Amazon Creek.	Periodic edge mowing, resurfacing	Local	
	Provide other recreational facilities	• Social (facility, community amenity)	Varies	Point or Segment	Medium			Local	
	Interpretive displays/Outdoor classrooms	• Social (facility, access, community amenity)	Varies	Point-Specific	Medium			Local	
	Acquire land for public use	• Social (facility, access, community amenity)	Varies	Watershed	Long				

Cedar Creek Restoration Options

Cedar Creek Planning Area

Reach Restoration Options

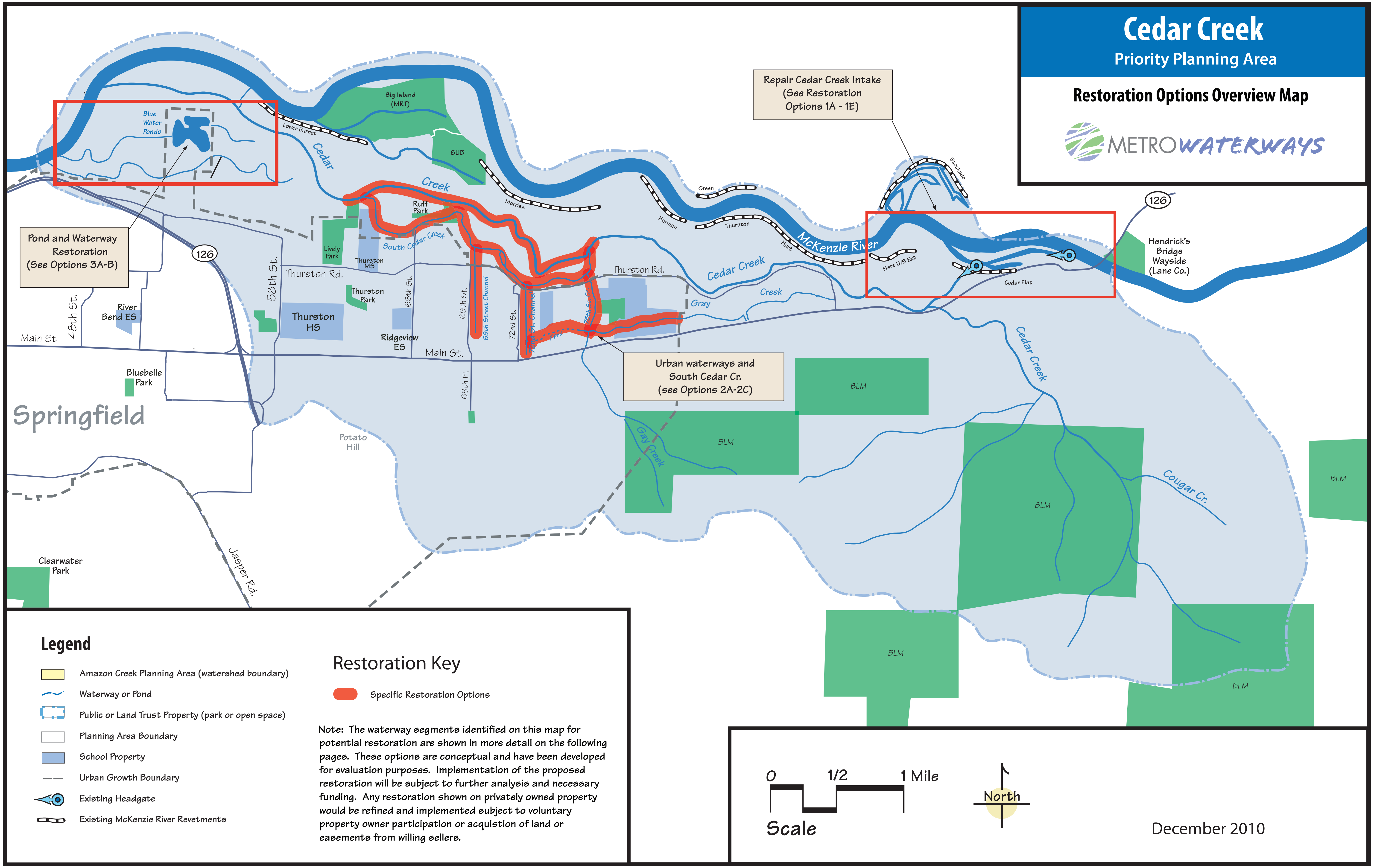
The draft restoration options shown are for evaluation purposes and will be modified based on technical evaluation and public input. Any proposed restoration shown on land that is currently in private ownership would be subject to cooperation from property owners or acquisition from willing sellers.

March 2011

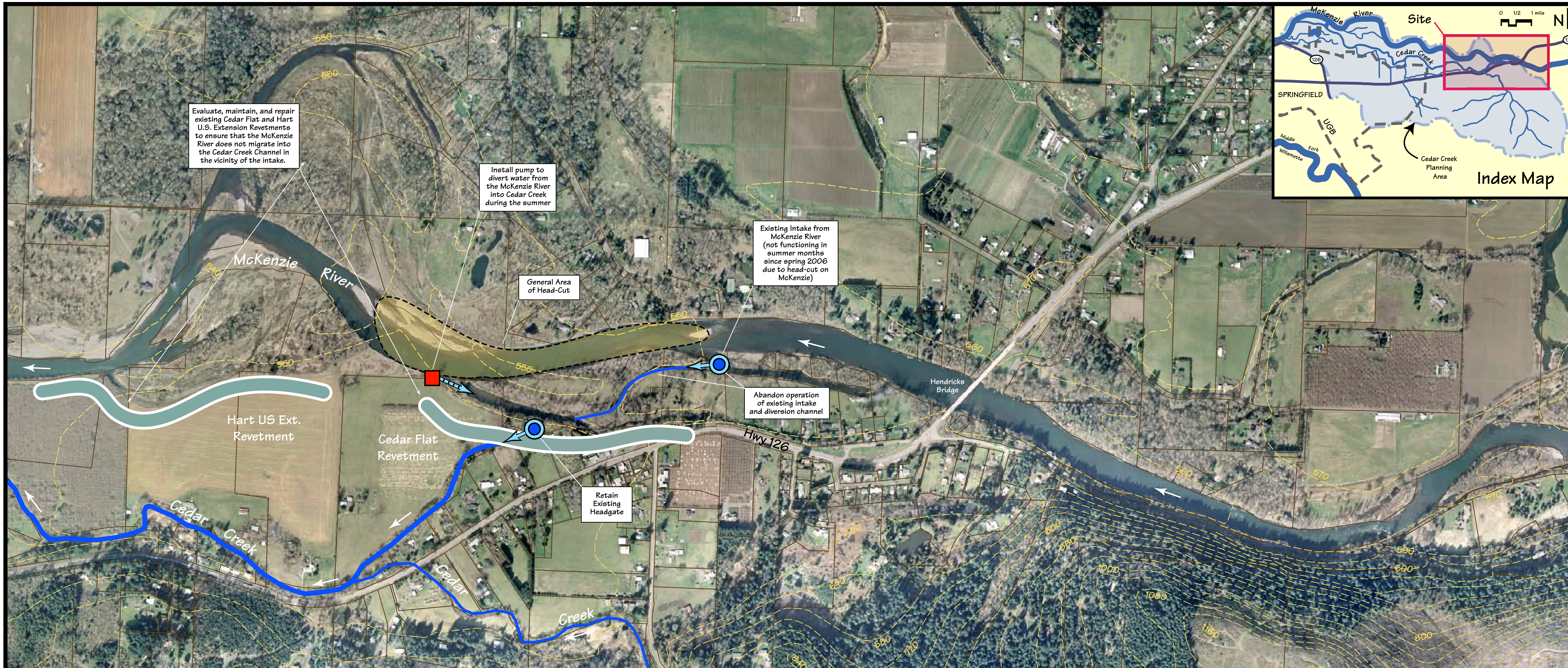
Cedar Creek

Priority Planning Area

Restoration Options Overview Map



Note: The waterway segments identified on this map for potential restoration are shown in more detail on the following pages. These options are conceptual and have been developed for evaluation purposes. Implementation of the proposed restoration will be subject to further analysis and necessary funding. Any restoration shown on privately owned property would be refined and implemented subject to voluntary property owner participation or acquistion of land or easements from willing sellers.



Restoration Concept Diagram
Cedar Creek

Cedar Creek Intake: Option 1A

METROWATERWAYS

Waterway Assessment Results

Cedar Creek Intake Reach Option 1A	Physical Condition	Water Resources	Natural Resources	Recreation	Total
Highest Possible Score	40.0	40.0	50.0	30.0	160.0
Existing Score	16.0	17.0	22.0	5.0	60.0
Projected Score*	23.0	22.0	22.0	5.0	72.0

*Projected score is based on successful implementation of the restoration

Legend

- Existing Waterways
- Tax Lot Lines
- Existing Cedar Creek Intake Structures
- General Area of Headcutting
- Install Pump (dry season operation)
- Evaluate and Repair Revetments

N W E S

0 400 800 Feet

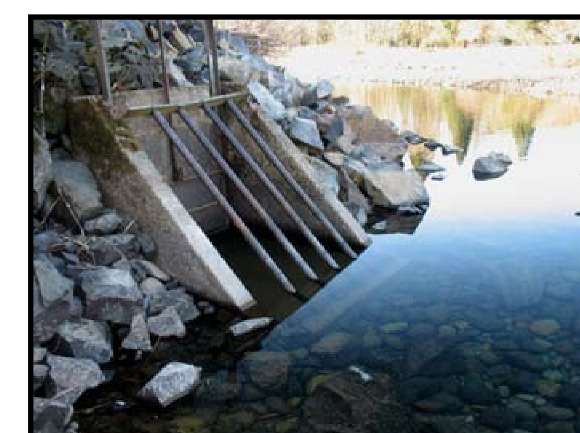
Scale

Draft: September 2009

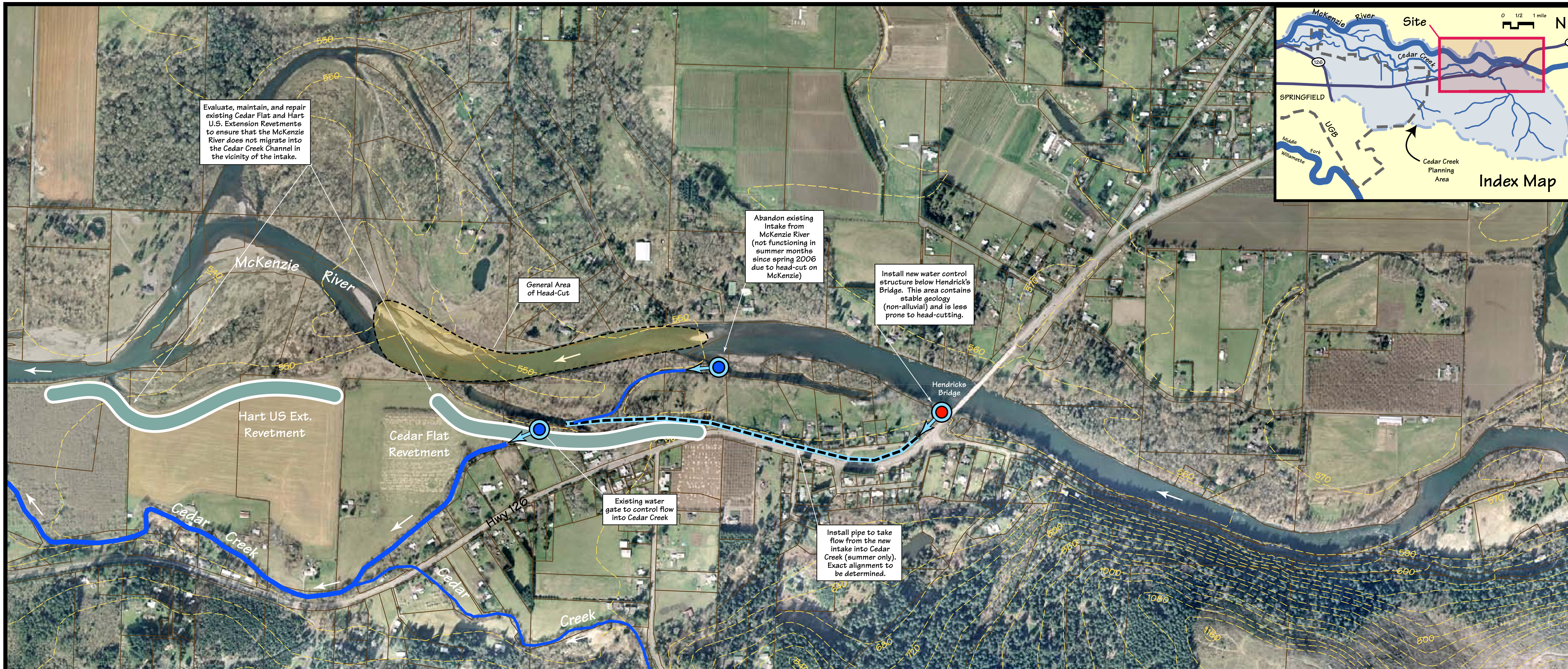
Produced by LCOG

Aerial Photo Base: Spring 2008

The McKenzie side channel where the current headgate is located (February 2006)



Water control gate at the head of Cedar Creek (February 2006)



Restoration Concept Diagram
Cedar Creek

Cedar Creek Intake: Option 1B

METROWATERWAYS

Cedar Creek Intake Reach Option 1B	Physical Condition	Water Resources	Natural Resources	Recreation	Total
Highest Possible Score	40.0	40.0	50.0	30.0	160.0
Existing Score	16.0	17.0	22.0	5.0	60.0
*Projected Score	23.0	22.0	22.0	5.0	72.0

*Projected score is based on successful implementation of the restoration

Legend

- Existing Waterways
- Tax Lot Lines
- Existing Cedar Creek Intake Structures
- New Intake Structure
- Pipe (to carry flow from McKenzie)*
- Evaluate and Repair Revetments

*Proposed restoration shown on property that is currently in private ownership are subject to cooperation from property owners and/or acquisition of land or easements from willing sellers.

N W E S

0 400 800 Feet

Scale

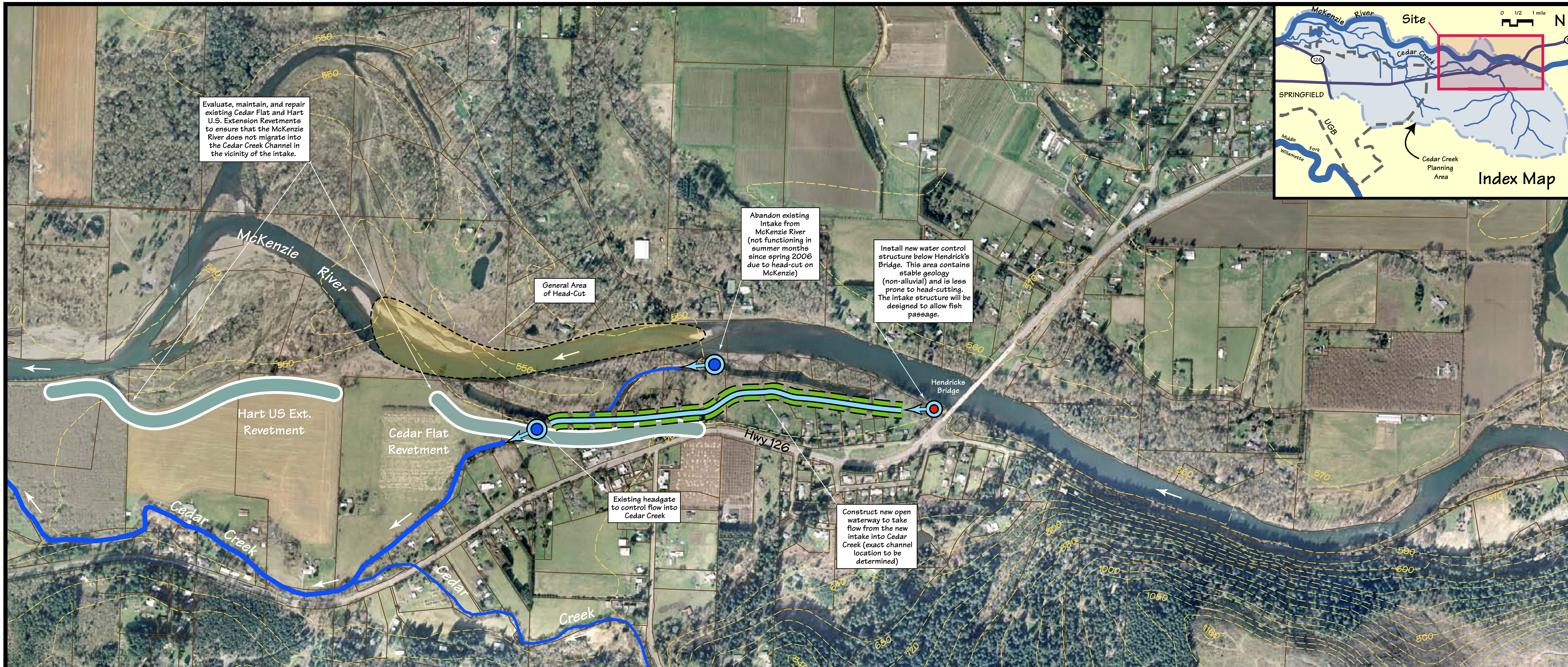
Draft: September 2009

Produced by LCOG

Aerial Photo Base: Spring 2008

The McKenzie side channel where the current intake structure is located (February 2006)

Water control gate at the head of Cedar Creek (February 2006)



Restoration Concept Diagram
Cedar Creek

Cedar Creek Intake: Option 1C

METRO WATERWAYS

Cedar Creek Intake Reach Option 1C	Physical Condition	Water Resources	Natural Resources	Recreation	Total
Highest Possible Score	40.0	40.0	50.0	30.0	160.0
Existing Score	16.0	17.0	22.0	5.0	60.0
*Projected Score	33.0	30.0	32.0	5.0	100.0

*Projected score is based on successful implementation of the restoration

Legend

- Existing Waterways
- Tax Lot Lines
- Existing Cedar Creek Intake Structures
- Potential New Intake Structure
- New Channel (to carry flow from McKenzie)*
- Riparian Vegetation along New Channel
- Evaluate and Repair Revetments

*Proposed restoration shown on property that is currently in private ownership are subject to cooperation from property owners and/or acquisition of land or easements from willing sellers.

N W E S

0 400 800 Feet

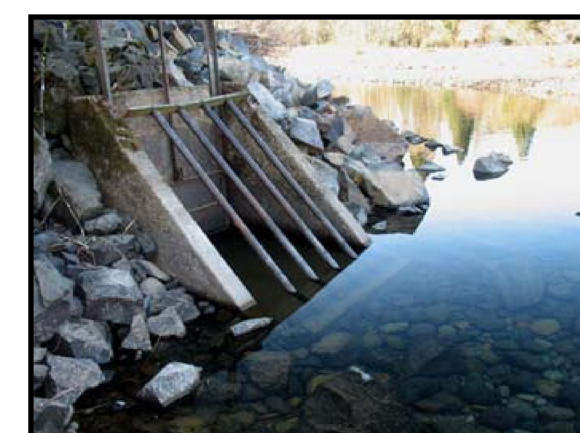
Scale

Draft: September 2009

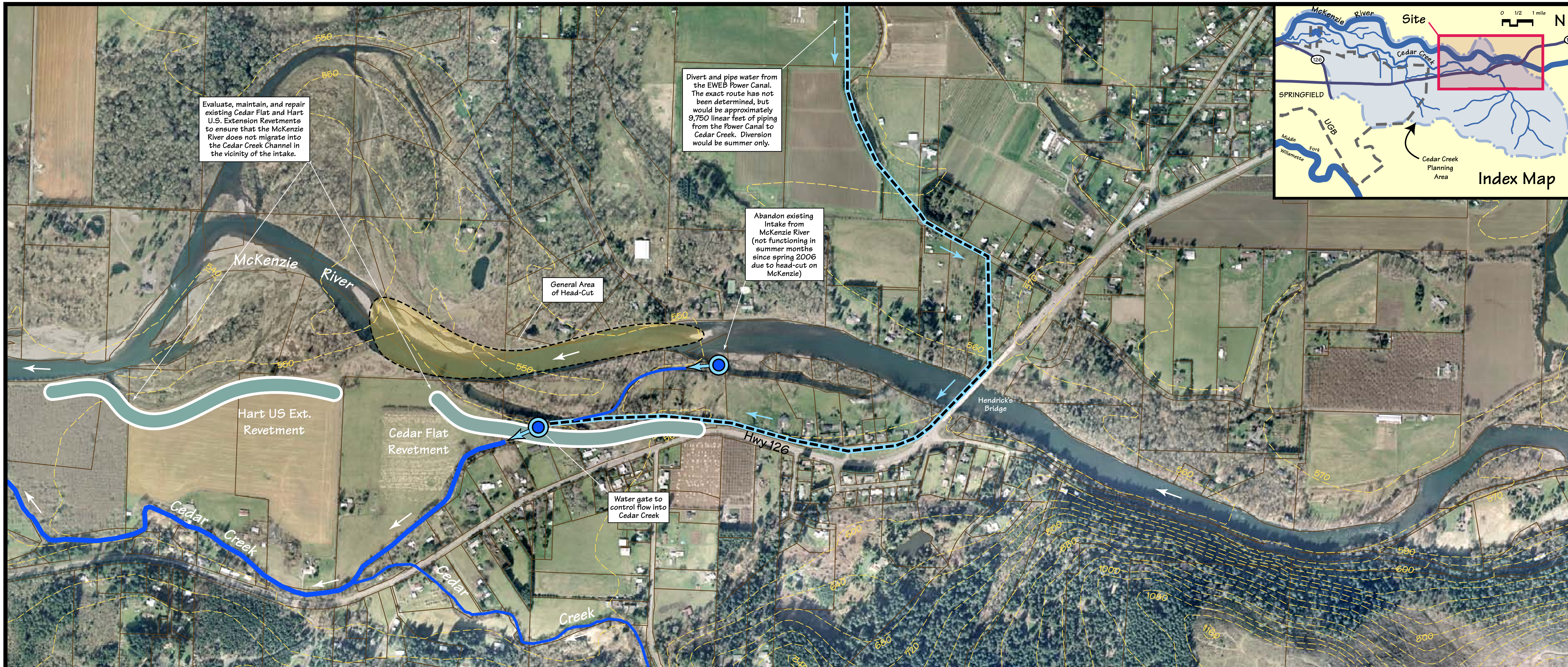
Produced by LCOG

Aerial Photo Base: Spring 2008

The McKenzie side channel where the current intake structure is located (February 2006)



Water control gate at the head of Cedar Creek (February 2006)



Restoration Concept Diagram
Cedar Creek

Cedar Creek Intake: Option 1D

METROWATERWAYS

Cedar Creek Intake Reach Option 1D	Physical Condition	Water Resources	Natural Resources	Recreation	Total
Highest Possible Score	40.0	40.0	50.0	30.0	160.0
Existing Score	16.0	17.0	22.0	5.0	60.0
*Projected Score	23.0	21.0	22.0	5.0	71.0

*Projected score is based on successful implementation of the restoration

Legend

- Existing Waterways
- Tax Lot Lines
- Existing Cedar Creek Intake Structure
- Pipe (to carry flow from EWEB Power Canal)*
- General Area of Headcutting
- Evaluate and Repair Revetments

*Proposed restoration shown on property that is currently in private ownership are subject to cooperation from property owners and/or acquisition of land or easements from willing sellers.

N W E S

0 400 800 Feet

Scale

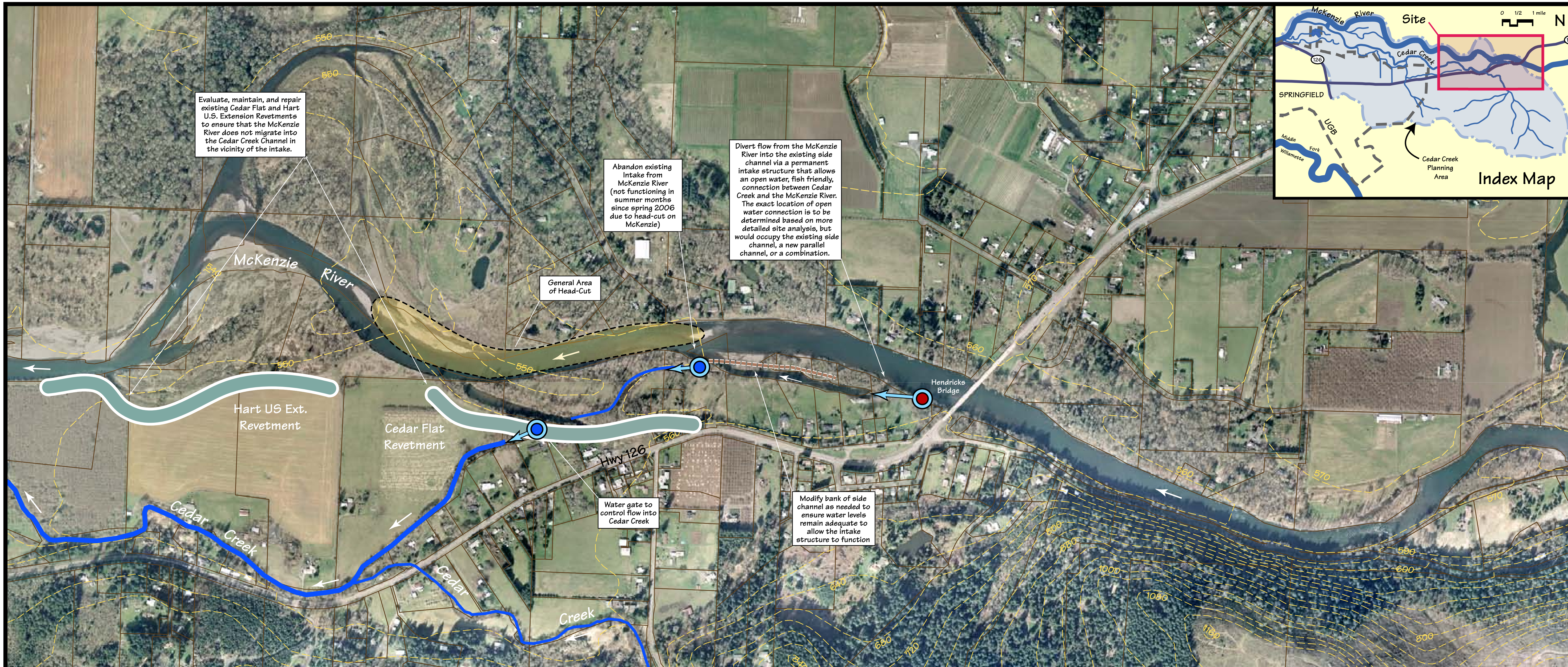
Draft: September 2009

Produced by LCOG

Aerial Photo Base: Spring 2008

The McKenzie side channel where the current intake structures are located (February 2006)

Water control gate at the head of Cedar Creek (February 2006)



Restoration Concept Diagram Cedar Creek

Cedar Creek Intake: Option 1E

METRO WATERWAYS

Cedar Creek Intake Reach Option 1E	Physical Condition	Water Resources	Natural Resources	Recreation	Total
Highest Possible Score	40.0	40.0	50.0	30.0	160.0
Existing Score	16.0	17.0	22.0	5.0	60.0
*Projected Score	37.0	30.0	37.0	5.0	109.0

*Projected score is based on successful implementation of the restoration

Legend

- Existing Waterways
- Tax Lot Lines
- General Area of Headcutting
- Existing Cedar Creek Intake Structure
- Potential New Intake Structure (flow diversion from McKenzie)
- Evaluate and Repair Existing Revetments

** Proposed restoration shown on property that is currently in private ownership are subject to cooperation from property owners and/or acquisition from willing sellers.*

N W E S

0 400 800 Feet

Scale

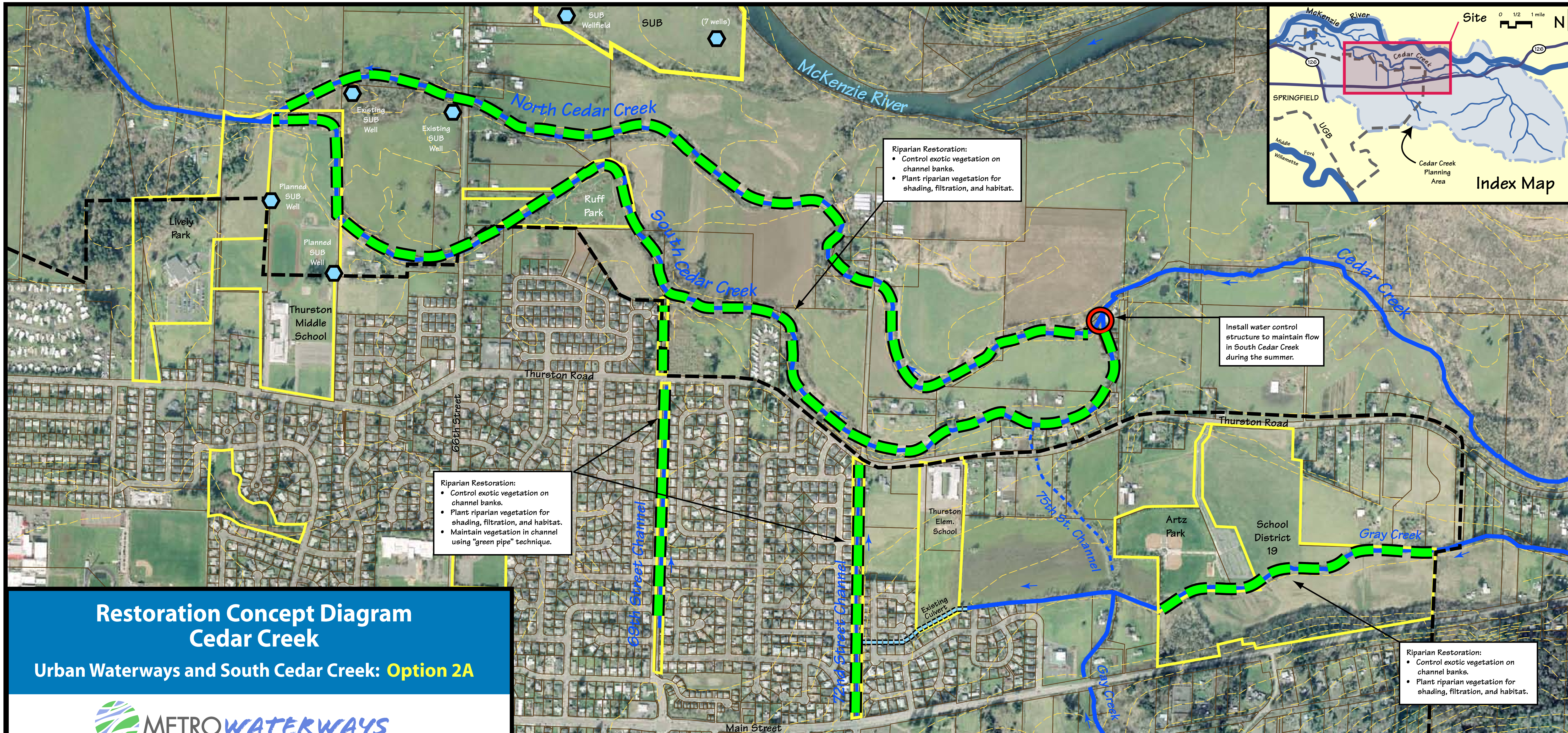
Draft: September 2009

Produced by LCOG

Aerial Photo Base: Spring 2008

The McKenzie side channel where the current intake structures are located (February 2006)

Water control gate at the head of Cedar Creek (February 2006)



Restoration Concept Diagram
Cedar Creek

Urban Waterways and South Cedar Creek: Option 2A

METRO WATERWAYS

Reach Option 2A	Physical Condition (40 possible points)		Water Resources (40 possible points)		Natural Resources (40 possible points)		Recreation (30 possible points)		Total Points	
	Existing	Projected*	Existing	Projected*	Existing	Projected*	Existing	Projected*	Existing	Projected*
Gray Creek	19.0	19.0	18.0	26.0	21.0	31.0	11.0	11.0	69.0	87.0
75th Street Channel	16.0	16.0	15.0	15.0	15.0	15.0	7.0	7.0	53.0	53.0
South Cedar Creek	24.0	26.0	19.0	26.0	27.0	38.0	10.0	10.0	80.0	100.0
72nd Street Channel	19.0	19.0	17.0	24.0	12.0	22.0	17.0	17.0	65.0	82.0
69th Street Channel	14.0	16.0	11.0	22.0	11.0	27.0	15.0	15.0	51.0	80.0

*Projected score is based on successful implementation of the restoration

0 400 800 Feet

Scale

N W E S

Draft: October 2009

Produced by LCOG

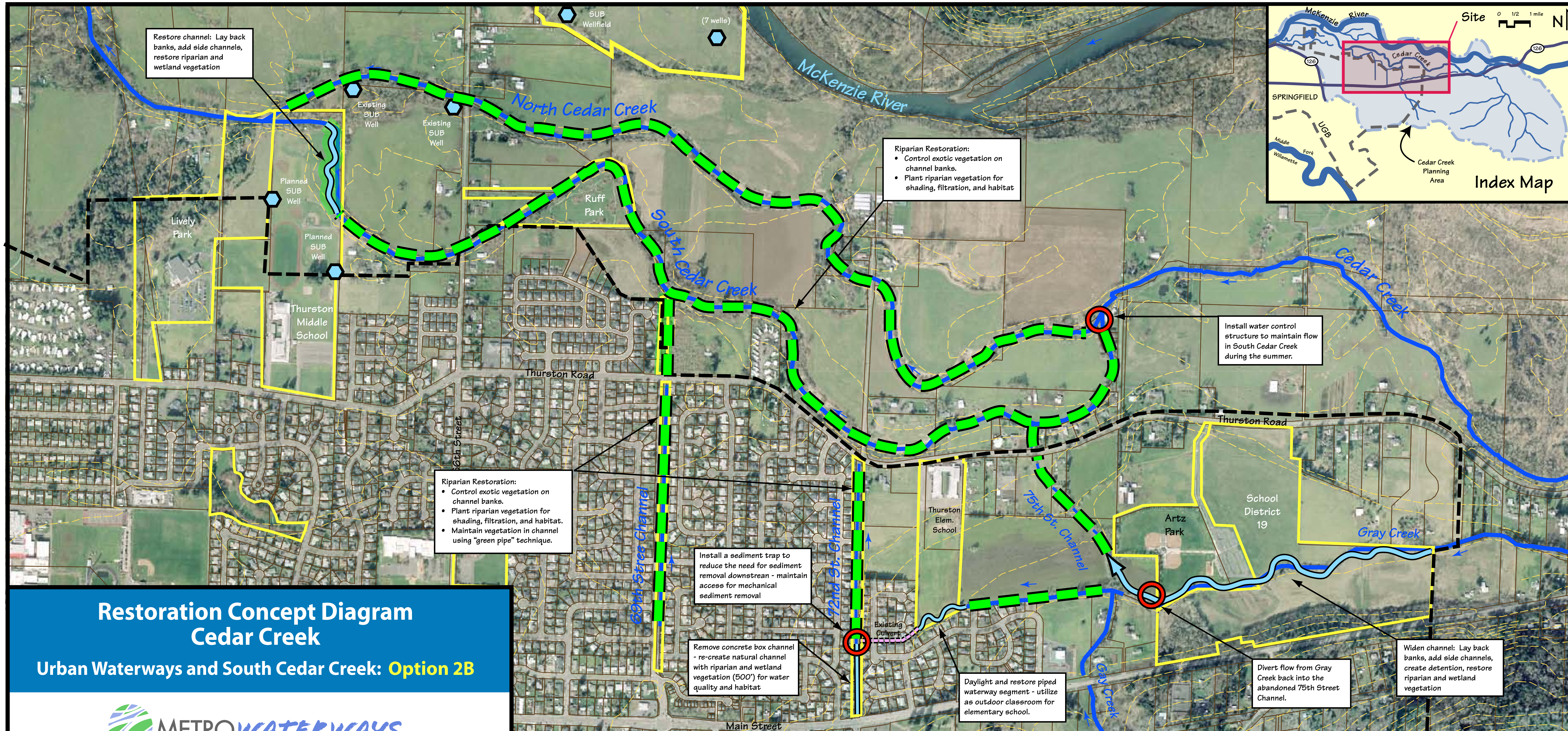
Aerial Photo Base: Spring 2008

Legend

- Existing Waterways
- Tax Lot Lines
- Public Lands (schools and parks)
- Urban Growth Boundary
- Proposed Riparian Restoration*
- SUB Wellfields (existing and planned)

* *Proposed waterway restoration shown on property that is currently in private ownership are subject to cooperation from property owners or acquisition of land or easements from willing sellers.*

South Cedar Creek at Thurston Middle School



Restoration Concept Diagram
Cedar Creek

Urban Waterways and South Cedar Creek: Option 2B

METRO WATERWAYS

Reach Option 2B	Physical Condition (40 possible points)		Water Resources (40 possible points)		Natural Resources (40 possible points)		Recreation (30 possible points)		Total Points	
	Existing	Projected*	Existing	Projected*	Existing	Projected*	Existing	Projected*	Existing	Projected*
Gray Creek	19.0	36.0	18.0	33.0	21.0	39.0	11.0	11.0	69.0	119.0
75th Street Channel	16.0	23.0	15.0	28.0	15.0	32.0	7.0	7.0	53.0	90.0
South Cedar Creek	24.0	27.0	19.0	30.0	27.0	45.0	10.0	16.0	80.0	118.0
72nd Street Channel	19.0	24.0	17.0	28.0	12.0	26.0	17.0	17.0	65.0	95.0
69th Street Channel	14.0	16.0	11.0	22.0	11.0	27.0	15.0	15.0	51.0	80.0

*Projected score is based on successful implementation of the restoration

0 400 800 Feet
Scale

N W E S

Draft: October 2009

Produced by LCOG

Aerial Photo Base: Spring 2008

Legend

- Existing Waterways
- Tax Lot Lines
- Public Lands (schools and parks)
- Urban Growth Boundary
- Proposed Riparian Restoration
- Major Channel Restoration/Daylighting*
- SUB Wellfield (existing /planned)

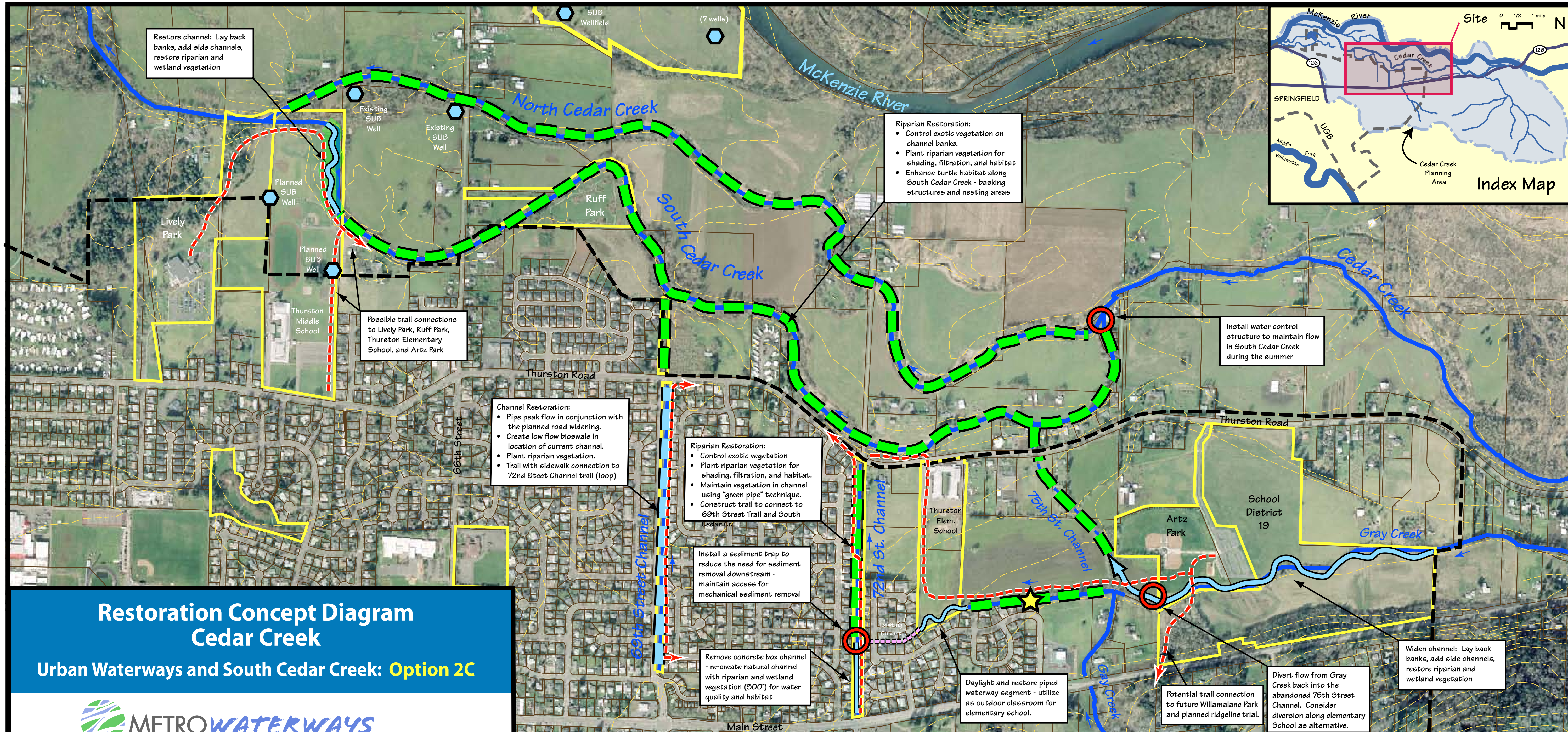
* Proposed restoration shown on property that is currently in private ownership is subject to cooperation from property owners or acquisition of land or easements from willing sellers.

72nd Street Channel

Restoration Concept Diagram
Cedar Creek

Urban Waterways and South Cedar Creek: Option 2C

METRO WATERWAYS



Reach Option 2C	Physical Condition (40 possible points)		Water Resources (40 possible points)		Natural Resources (40 possible points)		Recreation (30 possible points)		Total Points	
	Existing	Projected*	Existing	Projected*	Existing	Projected*	Existing	Projected*	Existing	Projected*
Gray Creek	19.0	36.0	18.0	33.0	21.0	39.0	11.0	20.0	69.0	128.0
75th Street Channel	16.0	23.0	15.0	28.0	15.0	32.0	7.0	12.0	53.0	95.0
South Cedar Creek	24.0	27.0	19.0	30.0	27.0	45.0	10.0	22.0	80.0	124.0
72nd Street Channel	19.0	24.0	17.0	28.0	12.0	26.0	17.0	23.0	65.0	101.0
69th Street Channel	14.0	16.0	11.0	22.0	11.0	27.0	15.0	15.0	51.0	80.0

*Projected score is based on successful implementation of the restoration

0 400 800 Feet

Scale

N W E S

Draft: October 2009

Produced by LCOG

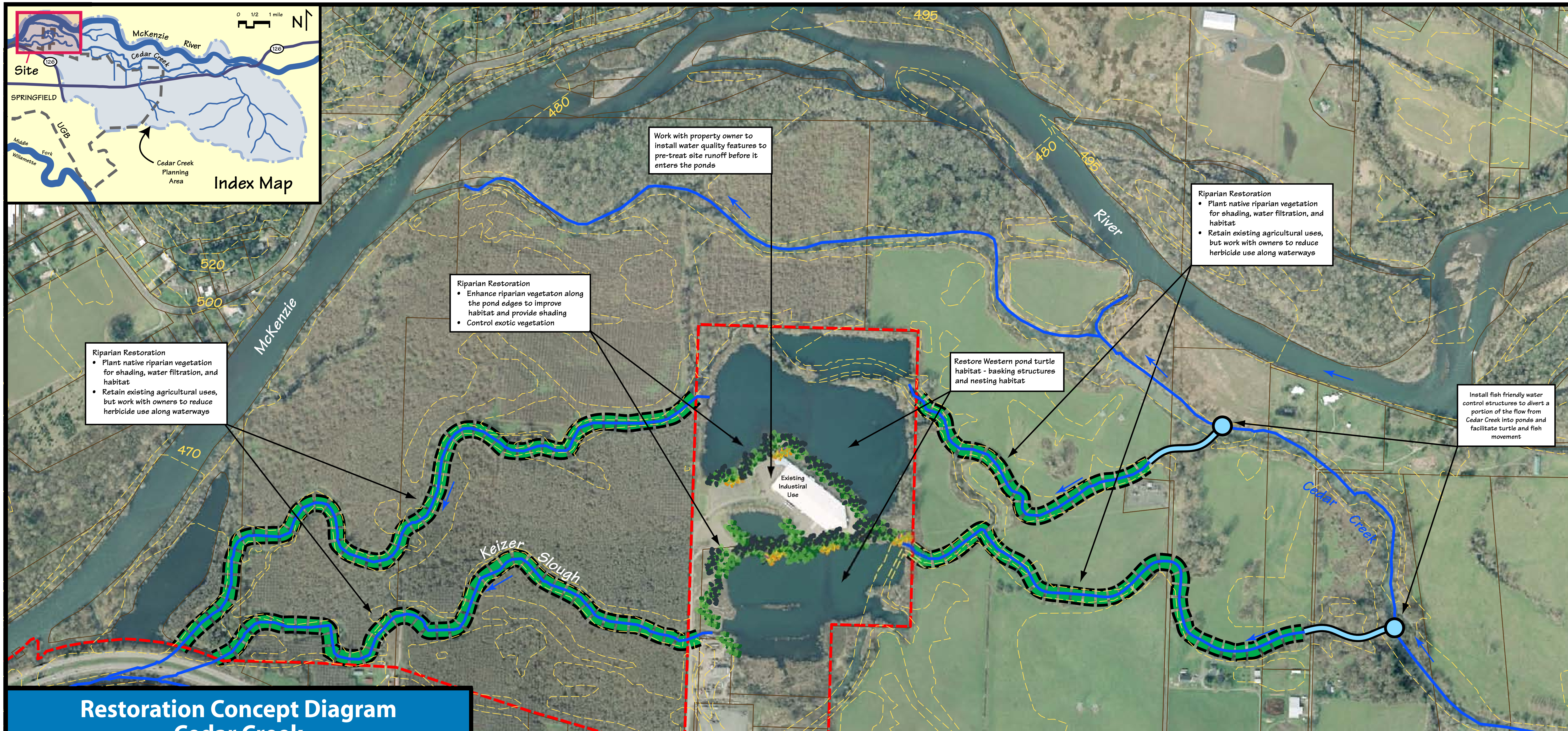
Aerial Photo Base: Spring 2009

*** Proposed trails and waterway restoration shown on property that is currently in private ownership are subject to cooperation from property owners or acquisition of land or easements from willing sellers. Trail network may also function as maintenance access.*

Legend

- Existing Waterways
- Tax Lot Lines
- Public Lands (schools, parks)
- Urban Growth Boundary
- Riparian Restoration
- Parallel Piping with Low Flow Bioswale
- Major Channel Restoration/Daylighting**
- Potential Waterway Corridor Acquisition**
- Potential Pedestrian Trail**
- SUB Wellfield (existing/planned)

South Cedar Creek at Thurston Middle School



Restoration Concept Diagram
Cedar Creek

Blue Water Ponds and Vicinity: Option 3A

METROWATERWAYS

Reach Option 3A - Blue Water Ponds	Physical Condition	Water Resources	Natural Resources	Recreation	Total
Highest Possible Score	40.0	40.0	50.0	30.0	160.0
Existing Score	17.0	19.0	22.0	3.0	61.0
*Projected Score	26.0	27.0	36.0	3.0	92.0

*Projected score is based on successful implementation of the restoration

Legend

- Existing Waterways
- Tax Lot Lines
- Urban Growth Boundary
- Riparian Restoration (ponds)*
- Riparian Restoration (waterways)*
- Improved Wateway Connection*

N
W E
S

0 400 800 Feet
Scale

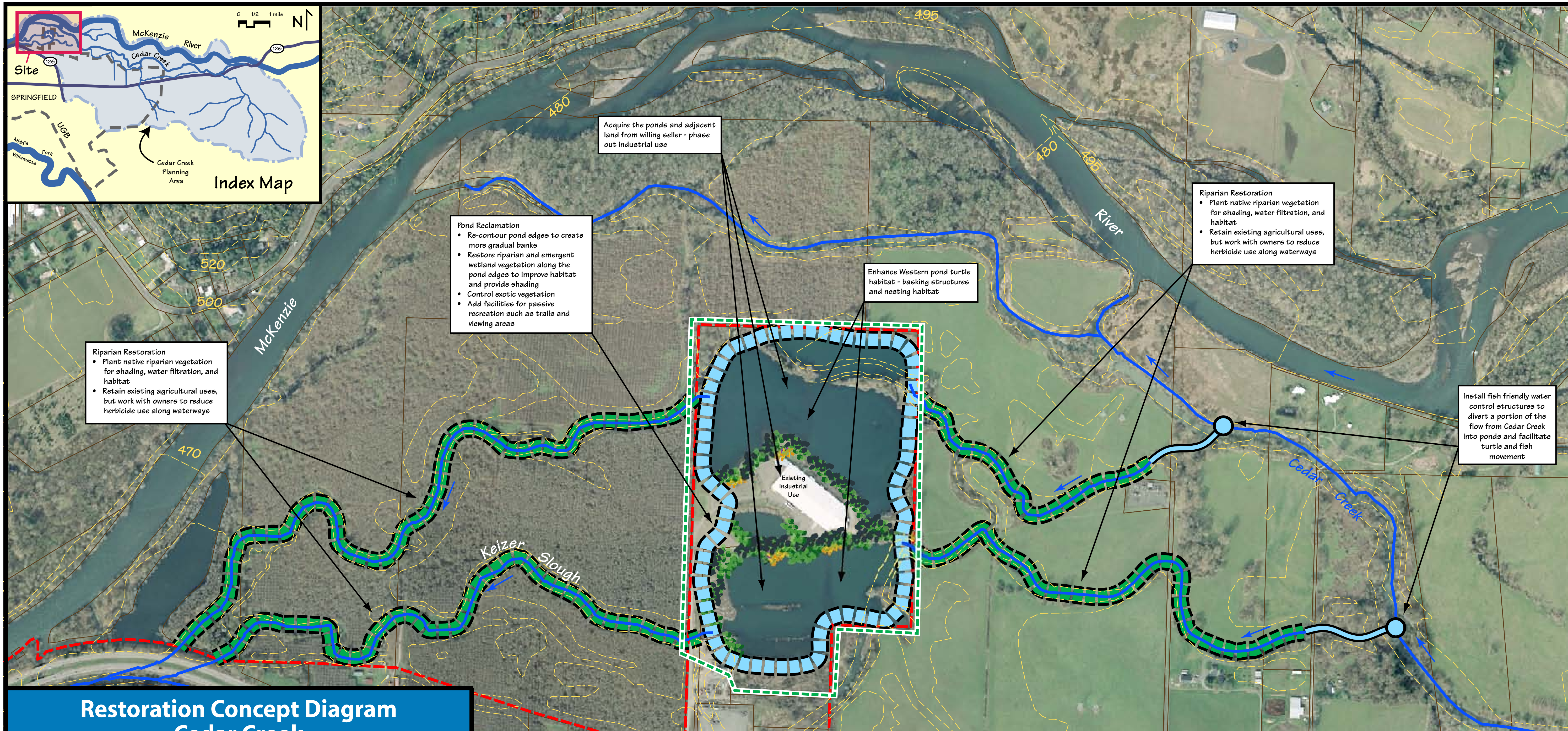
Draft: September 2009

Produced by LCOG

Aerial Photo Base: Spring 2008

* Proposed restoration shown on property that is currently in private ownership are subject to cooperation from property owners or acquisition of land or easements from willing sellers.

Blue Water Ponds (viewed from the south)



Restoration Concept Diagram
Cedar Creek

Blue Water Ponds and Vicinity: Option 3B

METROWATERWAYS

Reach Option 3B - Blue Water Ponds	Physical Condition	Water Resources	Natural Resources	Recreation	Total
Highest Possible Score	40.0	40.0	50.0	30.0	160.0
Existing Score	17.0	19.0	22.0	3.0	61.0
Projected Score*	31.0	29.0	47.0	14.0	121.0

*Projected score is based on successful implementation of the restoration

Legend

- Existing Waterways
- Tax Lot Lines
- Urban Growth Boundary
- Riparian Enhancement (waterways)*
- Riparian Enhancement (ponds)*
- Improved Wateway Connection
- Recontour Banks and Establish Native Vegetation
- Target Aquisition Area*

* Proposed restoration shown on property that is currently in private ownership are subject to cooperation from property owners or acquisition from willing sellers.

N W E S

0 400 800 Feet
Scale

Draft: September 2009

Produced by LCOG

Aerial Photo Base: Spring 2008

Note: Reclamation proposal shown above is conceptual. Additional site analysis will be required to refine the concept.

Blue Water Ponds (viewed from the south)

Cost Effective Plans

Total and Average Cost

12/11/2013

Cost Effective Plan Alternatives

Planning Set: Cedar Creek CEICA 11DEC2013

Counter	Name	Output HU	Cost $	Average Cost
1	No Action Plan	0.00	0.00	
2	A1B0C0	2.00	276,680.00	138,340.00
3	A5B0C0	7.80	283,769.00	36,380.64
4	A1B1C0	11.35	336,264.00	29,626.78
5	A5B1C0	17.15	343,353.00	20,020.58
6	A1B0C1	28.22	414,348.00	14,682.78
7	A5B0C1	34.02	421,437.00	12,387.92
8	A1B1C1	37.57	473,932.00	12,614.64
9	A5B1C1	43.37	481,021.00	11,091.10
10	A1B2C1	49.22	683,599.00	13,888.64
11	A5B2C1	55.02	690,688.00	12,553.40
12	A5B1C2	58.15	763,190.00	13,124.51
13	A1B2C2	64.00	965,768.00	15,090.13
14	A5B2C2	69.80	972,857.00	13,937.78
15	A5B3C2	70.05	1,048,697.00	14,970.69

Best Buy Plans

Incremental Cost of Best Buy Plan Combinations (Ordered By Output)

12/11/2013 12:40:55PM

Planning Set: Cedar Creek CEICA 11DEC2013

Counter	Plan Alternative	Output (HU)	Cost ($)	Average Cost ($ / HU)	Incremental Cost ($)	Inc. Output (HU)	Inc. Cost Per Output
1	No Action Plan	0.00	0.00				
2	A5B1C1	43.37	481,021.00	11,091.0998	481,021.0000	43.3700	11,091.0998
3	A5B2C1	55.02	690,688.00	12,553.3988	209,667.0000	11.6500	17,997.1674
4	A5B2C2	69.80	972,857.00	13,937.7794	282,169.0000	14.7800	19,091.2720
5	A5B3C2	70.05	1,048,697.00	14,970.6924	75,840.0000	0.2500	303,360.0000